ANNOTATED EDITORIAL INDEX

Electrical Manufacturing

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New Relay Forms for A-C Operation, R. J. Coppola Existing relays for intrinsic a-c operation using shading coils or polyphase windings, and the various means of operating relays on a-c using auxiliaries such as rectifiers and capacitors all have shortcomings. Presented here are the details in the development of basically new forms of a-c relays, with the electromagnetic design analysis.	Oct	156
Components for Printed Wiring, W. W. Deckert Detailed description with pictures and outline drawings of current electromechanical component developments sponsored by U.S. Army Signal Engineering Laboratories. Most recent developments include a vertically mounted octal socket, a vertically mounted in-line socket for subminiature flat-press tubes, a vertical and a right-angle mounted transistor socket, a low-voltage subminiature plug and receptacle and a subminiature rotary switch. Reliable components for the equipment design engineer are described and illustrated in detail in this article.	Sep	92
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Relay Design Targets Set by Missile Survey, Staff Report Oklahoma A. & M. College continues Symposium on Electro-Magnetic Relays, now in its fifth year. Conference between relay users and makers shows progress in standarization efforts, primary attention going to terminology and testing definitions. Costly over-specifications and contradictory requirements by users and over-design by makers are results of uncertainty in meaning of testing terms and methods. Navy survey of missile applications provides a continuing punched card file of relay data for defining requirements on an orderly basis.	Jun	118
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Capacitors		
A High-K Ceramic Capacitor for 200 C Application, C. A. Shaw A new type ceramic dielectric is described which will withstand electrical stress of over 50 volts per mil at 200 C. Behavior of dielectric constant, dissipation factor, and insulation resistance *vs* temperature are demonstrated.	Oct	163
Integration of Dielectric Materials, Processes, Components, A. E. Javitz Review of the 1957 symposium of the Electric Insulation Division, Electrochemical Society, covers the wide spectrum of basic and application research, encompasses not only materials but also integrated components and processes.	Jul	90
Fluorinated Liquid Dielectric for Fixed Paper Capacitors, T. D. Callinan and J. B. Romans Materials usable over a temperature range —65 C to 200 C have been developed from synthesis of partially fluorinated compounds. Properties of these materials and characteristics of impregnated capacitors are discussed in this report based on a Naval Research Laboratory program.	May	146
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Design and Application of Hysteresis Clutches, J. Winston Clutches having qualities of linearity and repeatability are of particular interest for use in control, consequently the hysteresis clutch has become an important control component. The details of mechanical and magnetic design are presented fully, including coil and temperature rise factors which are especially crit-	Dec	114

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ical under high altitude conditions. Circuit and other application factors are also thoroughly discussed.		
New Procedure for Designing Linear and Swinging Chokes, I. Richardson A new procedure to save the engineer's time in the design of linear and swinging chokes is described and illustrated with specific examples. Complete design data tables and curves are given.	Dec	136
Try Mercury Plunger Relays, J. J. Bernstein A review of the construction, operation, general characteristics, advantages and limitations of plunger-type mercury relays for power switching in applications requiring high reliability with no maintenance.	Nov	152
Transistor-Magnetic Amplifiers, N. Jasper, J. C. Taylor and W. T. White Optimum circuit design sometimes requires the peculiar characteristics of both transistor and magnetic amplifiers. Advantages and limitations of both are reviewed and seven combination circuits presented: three a-c servo amplifiers; pulse-width modulated d-c switch; d-c to a-c servo amplifier; a-c to d-c regulated power supply; low-level d-c harmonic-type amplifier.	Sep	82
Proposed Size Standards for Toroidal Magnetic Tape-Wound Cores, P. L. Schmidt Selection procedure followed and full text of standard proposed by Materials Subcommittee of AIEE Magnetic Amplifier Committee. Tables cover: (1) proposed standard dimensions, (2) commonly used core dimensions not included as proposed standards and (3) proposed standards for the choice of future core dimensions.	Sep	122
Minimizing Partially Developed Relay Tree Circuits, M. P. Marcus A relay tree circuit with n relays has 2^n possible outputs. When all outputs are utilized, the number of transfer contacts required is fixed at 2^{n-1}. But for a particular tree with less than 2^n outputs, the number of transfer contacts required is not fixed, and the circuit with minimum transfers is not always obvious. Article presents unique graphical method for "mapping" minimum-transfer circuits.	Aug	102
Design Procedures for Special Type High-Temperature Transformers—II, I. Remis Continuation of article begun in July (Part I, p. 116, 10 pp.) presents specific step-by-step design procedures for transformers of the following special types: Current limiting transformers, current limiting transformers with unbalanced d-c magnetization, and vibrator supply transformers. Design example is worked out for 400-cycle transformer for operation at 115 C rise over 85 C ambient.	Aug	119
Design Procedures for Special Type High-Temperature Transformers—I, I. Remis Specific design procedures for high-temperature transformers with unbalanced d-c magnetization.	Jul	116
Another Approach to Static Control, R. A. Sitts General Electric's new Static Switching Control for industrial equipment incorporates two separate systems: (1) a single-function logic element system for controls of moderate complexity and (2) a multi-function logic system for highly complex applications. Here's the full story to date on design, construction, operation, packaging and application.	Jun	100
High-Temperature Magnetic Amplifiers and Transformers, J. R. Walker and M. Frank This 5-watt operational amplifier, shown before encapsulation and after test, has been stabilized with thermistors for an ambient temperature range of —65 to +250 C and operated successfully for 3100 hr at 250 C. Only lack of suitable rectifiers prevents 500 C operation; similar transformer designs have already proven themselves at the higher temperature. Here are the highlights of an Air Force material-component development program evaluating magnetic core materials, conductors, insulation, rectifiers, core mounting methods and encapsulation techniques.	Jun	168
Liquid and Gas Dielectrics for Magnetic Component Miniaturization, L. F. Kilham, Jr. and R. R. Ursch Significant reduction in size and weight has been attained in transformer design by the use of fluorochemical liquids and gases in combination with various heat-conduction techniques. The fluorochemicals combine excellent characteristics as coolants with desirable dielectric and physical properties. These design methods appear applicable to magnetic components generally — for example, inductors and complete power supply packages.	May	140
Practical Iron Core Inductor Design Data, J. Scott Filter circuit inductors, in common with other iron core magnetic devices, resist purely analytical design since they involve nonlinear B/H characteristics plus physical winding space, insulation and temperature rise inter-relations. Optimal and rapid design must depend upon experience-gathered empirical data and methods such as those presented here for this important class of component.	May	154
What's Wrong with Plug-In Relays,? I. S. Mayer What's Wrong with Plug-In Relays? Plenty, says an Air Force development engineer who points out five major deficiencies, compared with what he terms the more reliable soldered-in types for military aircraft electronic applications. His comments are aimed at both relay designers and users.	Apr	148
Magnetic Amplifiers for Tension Control of Winder Drives, R E. Hull Here is the wind-up reel on the delivery end of a tandem cold strip mill. Maintaining constant tension on the strip is no easy trick because the coil radius is continually increasing as the reel winds up—unless the d-c reel motor can be slowed down to compensate. One way is to use magnetic amplifiers for tension control.	Apr	152
Applying High Permeability Laminations, W. S. Spring A quick review of basic design factors for high-nickel-alloy magnetic laminations, including the effects on a-c permeability of alloy composition, lamination shape and thickness, stacking and interleaving, superposed d-c fields and final heat treatment. Brand names and lamination symbols defined.	Mar	126
Considerations in the Design of Aluminum Foil Coils, H. O. Rost Experimental magnet coils wound from aluminum foil with capacitor kraft paper as layer insulation have proved to have superior heat distribution and space utilization, compared with copper wire. Coil weight was halved, material cost reduced 20 to 40 per cent.	Mar	163
Magnet Design: Two Practical Approaches 1. Estimating Leakage Factors for Permanent Magnets from Geometry of Magnetic Circuit, R. K. Tenzer Shows how to figure the leakage factors of various shaped permanent magnet circuits, and unsaturated electromagnetic circuits, by straight arithmetic using only the physical dimensions of the magnetic structure and a few rule-of-thumb constants.	Feb	94
2. Figuring Air Gaps for Maximum Pull of Opposing Electromagnets, K. W. Henderson Graphical method of determining the air gap for maximum initial pull for a given change from the initial ampere-turns of opposing (push-pull) electromagnets.	Feb	98
Static D-C References for Closed-Loop Controls, M. Mamon Many industrial controls require a source of accurately regulated d-c voltage to establish a base for input-output comparison. Recent	Jan	54

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developments in the magnetics and solid state fields have made available a variety of circuits having the reliability characteristic of static devices and able to furnish constant reference potential despite wide swings in input voltage.

Magnetic Materials Push Back Design "Stops," W. Arrott — Jan — 62
An advance look at new and improved magnetic materials, material-components and techniques as disclosed at the AIEE Conference on Magnetism and Magnetic Materials. Selected papers reviewed on Permanent Magnets, Soft Magnetic Materials, Ferrites and Thin Films, Test Methods and Apparatus, New Devices and Components.

Basic Considerations in Foil Transformer Production, W. Brackmann, R. Levinsohn and D. McCarthy — Jan — 94
Progress report on early development work being carried on under an Air Force contract to demonstrate feasibility of mechanizing small transformer (250 va max.) production using wafer coils spirally wound from aluminum or copper foil. Space factor of aluminum foil superior to copper magnet wire.

The Dry Circuit Problem, W. A. Scism, Sr. — Jan — 111
Some further thoughts on the unpredictable failure of relay contacts to close a circuit when handling milliamperes at millivolts, particularly important in military electronic systems. "Miss" test circuit illustrated.

Suppressing Corona in Flyback Transformers, Staff Report — Jan — 128

Printed Circuits

Characteristics of Metal-Clad Laminates, D. S. Hoynes — Apr — 104
Results of a Navy Bureau of Ships-sponsored project to develop design data on several types of metal-insulated laminates for printed-circuit work. Derived data deal with current-carrying capacity, electrical resistance of coated laminates, and dielectric properties.

Protective Devices

Start-Run Protection for Split-Phase Motors, J. Ellenberger — Jan — 90
Careful protection of split-phase motors yields more than just the benefit of safe operation. Higher torques in smaller frames can also be realized if the start-winding control is foolproof enough. New thermal devices promise to make such control feasible.

Resistors

Measurement of Resistor Temperature Coefficient, E. Thompson — Aug — 106
Effects of errors in maintaining nominal test temperature and in resistance bridge accuracy on temperature coefficient readings are shown graphically for standard temperature increments. A high accuracy resistance measuring bridge is described that uses a precision potentiometer and vacuum tube amplifier instead of decade resistances and is good for a range of ±500 ppm in TC measurement.

Functional Fixed Film Resistor Materials, A. E. Middleton — May — 149
Critical elements in the selection of optimum materials for film resistors are discussed. Various properties are compared and interpreted from the standpoint of today's ultimate objectives for resistors designed into an equipment required to operate under severe ambient conditions. The discussion emphasizes the need for tailoring resistor materials from synthesized structure.

Resistor Evaluation for Critical Applications, R. Davie, J. P. Gehegan and A. A. Andriolo — Jan — 74
The general practice of assigning tolerance and power ratings to resistors without regard to stability during operating life is of doubtful significance and is often a source of misinformation to equipment designers. A proper approach to specifying and derating resistors for specific applications is presented, with MIL-R-10509A resistors used as an example.

Semiconductor Devices

Design of Fins for Cooling of Semiconductors, W. Luft — Nov — 98
By employing a minimum of simplifying assumptions, a workable method of analytically designing cooling fins is derived. Semiconductors are used as a typical example of components which permit heat removal by the use of fins. Numerical examples and time-saving nomograms are included to support the general equations presented.

Specification and Measurement of Power Transistor Parameters, B. Reich — Nov — 149
A description of the most important power transistor parameters and applicable measurement circuits. Maximum voltage and current, collector and emitter cut-off current, large signal characteristics and transconductance are included.

Transistors in Airborne Power Supplies

A. Transistorized Cathode Ray Tube High-Voltage Supply, M. S. Chester — Oct — 149
Circuit and transformer design for a transistorized high-voltage power supply for cathode ray tube applications.

B. D-C to D-C Converter for a Telemetering Package, J. W. Moody — Oct — 152
Circuit and transformer design for a transistorized d-c to d-c converter.

Transistor-Magnetic Amplifiers, N. Jasper, J. C. Taylor and W. T. White — Sep — 82
Optimum circuit design sometimes requires the peculiar characteristics of both transistor and magnetic amplifiers. Advantages and limitations of both are reviewed and seven combination circuits presented: three a-c servo amplifiers; a-c to d-c regulated power supply; low-level d-c harmonic-type amplifier.

New Principle Employed in "Spacistor," Staff Report — Aug — 153

New Elements for Static Control, Staff Report — Jul — 106
Developments in high-performance d-c motors and d-c power sources also featured at 21st Westinghouse Machine Tool Electrification Forum: new Cypak static elements: output magnetic amplifier: half-shift register module; transistor NOR circuit: dynistor diode switch.

Transistor Circuitry for Digital Computers, P. E. Marenholtz and W. A. Scism — Jul — 113
Design notes for an adding register, read-in gate, and several forms of transistorized delay lines.

High-Temperature Magnetic Amplifiers and Transformers, J. R. Walker and M. Frank — Jun — 168
This 5-watt operational amplifier, shown before encapsulation and after test, has been stabilized with thermistors for an ambient temperature range of —65 to +250 C and operated successfully for 3100 hr at 250 C. Only lack of suitable rectifiers prevents 500 C operation: similar transformer designs have already proven themselves at the higher temperature. Here are the highlights of an Air Force material-component development program evaluating magnetic core materials, conductors, insulation, rectifiers, core mounting methods and encapsulation techniques.

Considerations in Testing Thermistors, M. L. Miller — May — 102
Proper measurement techniques described for thermistor acceptance and design testing include resistance, voltage, time delay and temperature-resistance slope.

Thermal Considerations in Power Transistor Applications, B. Reich — May — 162
Method of determining operating junction temperature of power transistors for steady state and transient conditions based on one thermal measurement and manufacturer's data.

Effect of Radiation on Semiconductors, J. C. Pigg and C. C. Robinson — Apr — 116

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When high-energy particle bombardment is part of the environment, circuit designs employing semiconductors must include consideration of the effects of crystal lattice disorder. Changes in characteristics of typical semiconductor components when subjected to various radiation levels are described.

Selenium Rectifiers for High-Voltage Power Supplies, V. Wouk — Mar — 166

Economic considerations in designing higher voltage power supplies indicate that selenium rectifier stacks are best for some applications but outclassed by vacuum tubes for others. Costs are compared for several typical high-voltage circuits.

Static D-C References for Closed-Loop Controls, M. Mamon — Jan — 54

Many industrial controls require a source of accurately regulated d-c voltage to establish a base for input-output comparison. Recent developments in the magnetics and solid state fields have made available a variety of circuits having the reliability characteristic of static devices and able to furnish constant reference potential despite wide swings in input voltage.

Switches

Adjustable Heat Anticipator for Room Thermostat, S. R. Mitick — Aug — 154

Ceramic Relay has Contacts in Vacuum, J. Daniels and L. B. Steward — Aug — 157

Transducers

High-Precision Electromechanical Linear Measuring Systems, F. Brouwer — Aug — 128

A frank discussion of accuracy, linearity, resolution and sources of error in position-measuring transducers suitable for closed-loop machine tool controls, including: differential transformers and capacitors; linear potentiometers; ultrasonic systems; lead screw and rack systems with rotary signal pickoffs; optical systems; digitally coded scales; plus the proprietary Pratt & Whitney "Electrolimit," Farrand "Inductosyn" and Canadian Westinghouse "Nultrax."

Signal Pickoffs for Control Systems—II, D. A. Davies — Mar — 159

Concluding a discussion of electrical signal pickoffs, this article covers the inductive and photoelectric types. These are two of the most important sources of input and feedback information for control operations.

Signal Pickoffs for Control Systems—I, D. A. Davies — Feb — 70

Descriptions of the seven major types of electrical pickoffs suitable for furnishing input and feedback signals for control operations. This first of two articles covers resistance, electrolytic, capacitive and piezoelectric devices and reviews the design and application factors ruling their use.

Strain Gages Measure Electrode Stresses, Staff Report — Feb — 142

Instrumentation Notes for Shock Tests

1. Measurements of Shock and Vibration Under Extreme Environmental Conditions, A. W. Orlacchio — Jan — 82

Types of vibration pickups are described together with factors to be considered in their selection for specific applications. Several examples are presented.

2. How to Select Electromagnetic Vibration Pickups, A. C. Diechmiller — Jan — 78

Design features and applications of vibration pickups for high-frequency vibration testing at high temperatures are described together with several calibration techniques.

Wire and Cables

Evaluation of Enameled Magnet Wire Properties and Applications, J. L. Saums and W. W. Pendelton — Oct — 129

A workable knowledge of magnet wire types, their advantages and limitations, as related to specific product applications, aids a design engineer in the selection of the best wire for his own purposes and in the specification of components and equipments that incorporate magnet wire. This review provides extensive property data on the major types of enameled wire, including those with newer enamels such as polyurethanes, nylon, epoxies, acrylics and polyesters, compares advantages and disadvantages, lists trade names.

R-F Power Ratings for Subminiature Coaxial Cables, G. J. Mares and N. J. Sladek — Jul — 140

Knowledge of power rating values is essential for proper applications of subminiature coaxial cables in electronic equipment. Miniaturization of equipment, higher power requirements, and subsequent higher ambient temperatures combine to create critical design problems. Suitable subminiature connector systems form a corrolary problem. Comparative data on polyethylene and two types of fluorocarbon dielectric coaxial cables are presented here; also on specially designed connector systems.

Aluminum-Clad Copper Magnet Wire for Elevated-Temperature Use, C. L. Carlson — Jun — 164

Composite wire combines the electrical conductivity of copper with the oxidation resistance of aluminum. In the range of 100 C to 300 C the loss of current-carrying ability is less than that of copper. Details of research and fabrication problems and some evaluation data for such applications as motor design are given in this report.

Developments in Polyethylene Insulation, A. E. Javitz — Mar — 108

Outstanding electrical properties of polyethylene have won for it wide acceptance as wire and cable insulation. Some deficiencies in properties limit greater use. As a result of developments in basic polymer chemistry, new types with improved properties are becoming available. This special report examines the new types, re-examines standard materials, and appraises application potentials.

Grounding Shielded Cables, M. C. Logan — Mar — 171

Wiring Devices

Terminal Stud Assembly for Maximum Reliability, G. H. Lines — Apr — 101

Assemblies of tubular rivet-type terminal studs in phenolic and silicone laminates were investigated to determine suitable mounting hole tolerances and to evaluate the effect of knurling of terminal shanks.

Military Solderless Termination Standardization, T. J. Horan — Apr — 161

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Drive Elements

Error Compensating Coupling for Rotary Controls, M. R. Alexy — Sep — 136

For synchros, potentiometers and other rotary control devices, a mechanical error compensator is described which is to be used between a driving shaft and the component requiring compensation. A feature of the design is that the series of settings around 360 deg are entirely independent, so that setting any one of them does not alter the others. The logic in the development and the design details are given.

Combining Hydraulic Torque Converters with A-C Motors, W. Howard — Feb — 90

Hydraulic torque converters offer interesting possibilities in shaping the speed-torque characteristics of a-c motors to suit high-inertia loads. Companion benefits afforded by use of converters are shock isolation and virtually unlimited overload protection.

Electric Clutch Couplings for Instrument Gear Trains, Staff Report — Feb — 121

Electric clutch couplings and brakes provide variable paper speeds from 3 to 400 in. per

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sec, preset automatic cutoff, constant paper tension and easy decoupling of paper rolls in new 16-channel cathode ray recording oscillograph for jet-engine and missile study, designed by William Miller Instruments, Inc.

Housings

Effect of Housing Design on Blower Performance, E. J. Brandt — Nov — 116
For the benefit of the designer of blower equipment employing single-inlet centrifugal impellers of the squirrel-cage type, effects on blower performance of variations in scroll shape and diffuser angle, housing width with respect to wheel width and axial placement of wheel, and shape of inlet ring are analyzed on the basis of laboratory test data.

Springs

Quick-Make Manual Circuit Breaker Mechanism, Staff Report — Dec — 150
Pictorial presentation of spring-operated "stored-energy" mechanism for minimizing arcing during contact closure of manually operated power circuit breaker by making contact-closing force and timing independent of operator's skill.

Constant-Force Springs Increase Brush Life, Staff Report — Feb — 139

Pre-assembled Belleville Spring Stacks, Staff Report — Jan — 114

CONTROL

Case Histories

Pulse Generator Replaces Gearbox of Numerically Controlled Lathe, A. Wang and G. Y. Chu — Dec — 130
Initial application to a contouring lathe of the Weditrol numerical control system for continuous control of two or more machine axes of motion through digital electrohydraulic servos with both rate and position feedback.

Stepless Switching Interpolates Punched-Card Position Data as Continuous Tool-Path Analog, Staff Report — Oct — 116
Utilizing precision toroidal autotransformers, induction potentiometers and rotary switches, the Cincinnati Milling Machine Company has achieved a numerically programmed analog control, with a resolution of 1 part in 100,000, for multi-axis contouring and profiling machines.

Simple Counter Detects Machine Drift, Staff Report — Oct — 154
Automatic size control of Heald Sizematic internal grinders is achieved by post-process gaging to pre-control limits. A fixed amount of machine correction is applied when, and only when, two successive pieces fall outside the pre-control zone in the same directions.

"Load-Started" Converter for Small-Boat Refrigerators, R. Simon — Oct — 196

Cycle Counting for Digital Timing Control, J. L. Solomon — Sep — 96
Detailed circuits as well as the overall block diagram are included in a description of the use of beam switching tubes as the nucleus of a system for counting power line cycles as a means of measuring time intervals. The application to resistance welding machines demonstrates the merits of this timing and programming method, which is essentially the use of digital techniques and circuits.

Program Control by Slider Switch or Punched Card, F. A. Manners and C. A. Schurr — Sep — 130
New programming devices such as slider switches and punched cards are added to reversing rolling mill control systems to provide rapid, automatic adjustment of the roll separation. New positioning system design also features magnetic amplifiers as static switching elements to control the screwdown drive motor.

Using Boolean Algebra to Design Static Control Circuits, Staff Report — Jul — 130
Baker Brothers, Inc. ranks among the first original equipment manufacturers to apply static logic elements to control circuits of their own design. Here is their approach to static circuit design, illustrated step-by-step with actual design worksheets documenting the evolution of a typical control circuit using Westinghouse Cypak logic elements. Primary feature of their Boolean algebra approach is that the final circuit is expressed in a universal language.

JIC Electrical Standards for Industrial Equipment, Joint Industry Conference — Jun — 127
Revised and adopted at the March 20-22, 1957 Joint Industry Conference, Detroit, Michigan.

Card Control of Boring Machine Includes Tool Selection, M. Morgan — Apr — 94
Automatic insertion and removal of tools in a vertical boring machine is governed by punched cards in a digital system which also handles coordinate positioning of work table, selection of spindle speeds and feed rate, plus depth control.

Relay Memory "Directs" Automatic Interfloor Conveyor, Staff Report — Apr — 110
Combining elevator and conveyor design practices, and using conventional machine-tool control components, the Gifford-Wood Co. has integrated 15 separate conveyors into a single package of original equipment.

Digital Positioning Control for Precision Jig Borer, E. E. Kirkham — Mar — 118
Adapting a proven combination micrometer and inductive bridge method of locating the worktable simplifies some of the accuracy problems in design of a numerical control for a precision machine tool, taking its instruction from punched tape. Features include use of conventional decimal digits plus an autotransformer digital-to-analog converter.

High Speed Digital Positioning with Binary-Coded Air Cylinders, G. E. Comstock, III — Feb — 116
Serially connected air cylinders can be used as digital positioning devices by operating each cylinder of the string as an independent binary element that extends or retracts its full stroke length in response to on-off electrical signals applied to its solenoid pilot valve. But smooth, precise performance poses a damping problem that can best be solved with built-in hydraulic damping, controlled by variable orifice.

Electric Clutch Couplings for Instrument Gear Trains, Staff Report — Feb — 121
Electric clutch couplings and brakes provide variable paper speeds from 3 to 400 in. per sec, preset automatic cutoff, constant paper tension and easy decoupling of paper rolls in new 16-channel cathode ray recording oscillograph for jet-engine and missile study, designed by William Miller Instruments, Inc.

Flywheel-Clutch Speed Starting of Standby Generator, W. S. Wiseman and J. C. Christiansen — Feb — 138

Systems and Servos

Design and Application of Hysteresis Clutches, J. Winston — Dec — 114
Clutches having qualities of linearity and repeatability are of particular interest for use in control, consequently the hysteresis clutch has become an important control component. The details of mechanical and magnetic design are presented fully, including coil and temperature rise factors which are especially critical under high altitude conditions. Circuit and other application factors are also thoroughly discussed.

Single Amplifier for Two Servos, B. Jacks — Dec — 147
Two methods, one based on phase differences and one on frequency differences, are presented for the application of a single power amplifier for two servos. The reduction in the number of components thereby decreases failure rates and provides for lowering of costs as well. The application is to multiple servo systems, both military and commercial.

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"Digimatic" Control for Contouring Machines, J. Rosenberg and W. Broadwell — Universality and simplicity of operation are the key features of a new all-automatic, digital control system using magnetic tape as the intermediary between computer and machine-mounted servos. Its application to a vertical milling machine and some of the detailed circuits of the servos are illustrated and discussed here.	Nov	104
Try Mercury Plunger Relays, J. J. Bernstein — A review of the construction, operation, general characteristics, advantages and limitations of plunger-type mercury relays for power switching in applications requiring high reliability with no maintenance.	Nov	152
Multi-Function Magnetic Amplifier Control for Large Motors, J. Baude — The use of both the dynamic and the static control characteristics of a magnetic amplifier for supervision of relays in the control and protective circuits of large synchronous motors is detailed. The theory of the magnetic amplifier role in this function is presented, with circuit diagrams and descriptions of the complete system.	Oct	170
Transistor-Magnetic Amplifiers, N. Jasper, J. C. Taylor and W. T. White — Optimum circuit design sometimes requires the peculiar characteristics of both transistor and magnetic amplifiers. Advantages and limitations of both are reviewed and seven combination circuits presented: three a-c servo amplifiers; pulse-width modulated d-c switch; d-c to a-c servo amplifier; a-c to d-c regulated power supply; low-level d-c harmonic-type amplifier.	Sep	82
Cycle Counting for Digital Timing Control, J. L. Solomon — Detailed circuits as well as the overall block diagram are included in a description of the use of beam switching tubes as the nucleus of a system for counting power line cycles as a means of measuring time intervals. The application to resistance welding machines demonstrates the merits of this timing and programming method, which is essentially the use of digital techniques and circuits.	Sep	96
Error Compensating Coupling for Rotary Controls, M. R. Alexy — For synchros, potentiometers and other rotary control devices, a mechanical error compensator is described which is to be used between a driving shaft and the component requiring compensation. A feature of the design is that the series of settings around 360 deg are entirely independent, so that setting any one of them does not alter the others. The logic in the development and the design details are given.	Sep	136
Automatic Tester Simulates Circuits for Control Panels, E. J. Loeffler and J. R. Longenecker — Descriptions of a "homemade" system for checking out, in a matter of minutes, complex machine tool control panels prior to mounting on the machine. Heart of system is motor-driven cam drum, made of wood, with associated limit switches and signal lights. Simulated circuit principles demonstrated by case history of automatic turret lathe.	Aug	97
Production Testing of Servomechanisms, H. R. Walker — For routinized testing and calibration of components and elements of complete servo systems, methods are derived from rigorous control theory. Illustrative loops and graphs are included to support the reasoning and as specific references for engineers having the problem of devising technically sound production test methods which are usable by medium-skilled production personnel.	Aug	114
High-Precision Electromechanical Linear Measuring Systems, F. Brouwer — A frank discussion of accuracy, linearity, resolution and sources of error in position-measuring transducers suitable for closed-loop machine tool controls, including: differential transformers and capacitors; linear potentiometers; ultrasonic systems; lead screw and rack systems with rotary signal pickoffs; optical systems; digitally coded scales; plus the proprietary Pratt & Whitney "Electrolimit," Farrand "Inductosyn" and Canadian Westinghouse "Nultrax."	Aug	128
New Elements for Static Control, Staff Report — Developments in high-performance d-c motors and d-c power sources also featured at 21st Westinghouse Machine Tool Electrification Forum: new Cypak static elements; output magnetic amplifier; half-shift register module; transistor NOR circuit; dynistor diode switch.	Jul	106
Dual Circuit Electronic Motor Control, J. J. Dailey, Jr. — Despite major advances in electron tube technology and quality control, these devices as a class exhibit failure patterns which are inherently random and unpredictable. This has created a dilemma for industrial control designers who must have the undisputed sensitivity and versatility of tubes but can not tolerate unpredictable equipment shutdown. Described here are two simple but effective expedients which permit the use of tubes on a motor regulating circuit for equipment drive in which continuous reliable operation is a paramount requirement.	Jul	144
Symbols and Terminology for Automatic Control Systems, Staff Report — A progress report of the work of several committees and an attempt to correlate the programs. Agreement reached on basic block diagram of a feedback control system.	Jul	149
Another Approach to Static Control, R. A. Sitts — General Electric's new Static Switching Control for industrial equipment incorporates two separate systems: (1) a single-function logic element system for controls of moderate complexity and (2) a multi-function logic system for highly complex applications. Here's the full story to date on design, construction, operation, packaging and application.	Jun	100
Transistor Magnetic Amplifier for Power Motor Control, M. Bracut and S. Weissman — Position or velocity command control of an integral-hp d-c servo motor can be obtained with the "Magnemax" system which takes low-level signals through a transistor preamplifier and a transistor magnetic amplifier. The latter governs field control and also armature control through a power saturable reactor.	Jun	157
Inherent Compensation in New Single-Stage Hydraulic Servo Valve, C. Beck — The very range and versatility of available pick-off devices for converting physical quantities into electrical information, and their complementary control amplifiers and motors, invite constantly expanding closed loop control application. For handling sizable power a weak link has been in electrohydraulic servo valves because of their inherent sensitivity to line pressures and load. Described here is the new Beck valve in which these deficiencies have been remedied, also selected system applications.	May	96
Mechanical Design Considerations for Automatic Controls, L.U.C. Kelling and G. L. Rogers — Achieving stability and accuracy in closed-loop servo controls involves comprehension of mechanical factors as well as electrical. The designer of automated machines needs to know how to compensate for back-lash, wind-up, stickiness, friction, deflection, vibration, and inertia of moving parts if human judgment is to be supplanted successfully by electrical controls.	May	132
"Inchworm" Motor Overcomes Stick-Slip Phenomenon, J. G. Rubenson and G. S. Butterworth — Magnetostriction effect is used to produce a linear actuator for ultra-precise positioning	May	136

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of machine tool slides. By eliminating wind-up inherent in lead screws, chattering of slides or stickiness due to difference between static and running friction is largely overcome.		
Relay Memory "Directs" Automatic Interfloor Conveyor, Staff Report — Combining elevator and conveyor design practices, and using conventional machine-tool control components, the Gifford-Wood Co. has integrated 15 separate conveyors into a single package of original equipment.	Apr	110
Magnetic Amplifiers for Tension Control of Winder Drives, R. E. Hull — Here is the wind-up reel on the delivery end of a tandem cold strip mill. Maintaining constant tension on the strip is no easy trick because the coil radius is continually increasing as the reel winds up—unless the d-c reel motor can be slowed down to compensate. One way is to use magnetic amplifiers for tension control.	Apr	152
Electronic Controls for Timed Acceleration of D-C Motors, P. A. Herrmann — Adjustable-voltage, variable-speed drives advance to a higher order of control as linear RC timing networks upgrade conventional programming circuits to Electronic Controls for Timed Acceleration of D-C Motors.	Mar	132
Signal Pickoffs for Control Systems—II, D. A. Davies — Concluding a discussion of electrical signal pickoffs, this article covers the inductive and photoelectric types. These are two of the most important sources of input and feedback information for control operations.	Mar	150
Signal Pickoffs for Control Systems—I, D. A. Davies — Descriptions of the seven major types of electrical pickoffs suitable for control operations. This first of two articles covers resistance, electrolytic, capacitive and piezoelectric devices and reviews the design and application factors ruling their use.	Feb	70
Static D-C References for Closed-Loop Controls, M. Mamon — Many industrial controls require a source of accurately regulated d-c voltage to establish a base for input-output comparison. Recent developments in the magnetics and solid state fields have made available a variety of circuits having the reliability characteristic of static devices and able to furnish constant reference potential despite wide swings in input voltage.	Jan	54
Theory		
Servo Motor Performance Under Unbalanced Conditions, T. N. Feng	Nov	166
Numbering Systems, I. L. Auerbach — Concept of number; difference between additive (Roman) and positional (Arabic) notation; basic equation defining binary, ternary, quaternary, quinary, decimal, duodecimal or any other positional numbering system; number conversion and basic arithmetic in various numbering systems; coded decimal numbers.	Sep	116
Minimizing Partially Developed Relay Tree Circuits, M. P. Marcus — A relay tree circuit with n relays has 2^n possible outputs. When all outputs are utilized, the number of transfer contacts required is fixed at 2^{n-1}. But for a particular tree with less than 2^n outputs, the number of transfer contacts required is not fixed, and the circuit with minimum transfers is not always obvious. Article presents unique graphical method for "mapping" minimum-transfer circuits.	Aug	102
Using Boolean Algebra to Design Static Control Circuits, Staff Report — Baker Brothers, Inc. ranks among the first original equipment manufacturers to apply static logic elements to control circuits of their own design. Here is their approach to static circuit design, illustrated step-by-step with actual design worksheets documenting the evolution of a typical control circuit using Westinghouse Cypak logic elements. Primary feature of their Boolean algebra approach is that the final circuit is expressed in a universal language.	Jul	130
Capsule Calculus, I. Ritow — A calculus refresher with the emphasis on understanding and developing a feeling for calculus rather than a facility for manipulating symbols to solve problems. Part I develops the basic principles of calculus and discusses differentiation and its uses. Part II discusses integration and its applications. Part III explains the use and meaning of differentiation and integration with respect to time and interprets equations of motion.	May	107
DESIGN CONSIDERATIONS		
Appearance		
Product Identification Plates as Designed-In Components, D. R. Witt — Nameplates, instruction plates, escutcheons, scale plates and simlar elements have both an appearance and functional purpose in product design. Each application should be based on proper use of optimum shape, color, type faces, selection of basic material and fabrication method. Specific design considerations are discussed, examples of good and bad design are cited, and a checklist of various types of identification plates related to application areas is provided.	Nov	122
Appearance Specifications and Control Methods, W. J. Kiernan — Appearance has increasingly become a "designed-in" element in any finished product. The color, gloss, and texture of exterior surfaces are important factors in styling and sales appeal, may have an important functional purpose also. The design engineer has a responsibility for selecting and specifying materials so that (1) appearance factors can be related to appropriate standards, and (2) effective process control methods can be established to assure uniformity in quality and characteristics. This article reviews basic premises of appearance control, theories of color specification, and available methods, instrumentation, standards and references.	Jul	126
Component Design Factors		
Analysis and Elimination of Corona Effects, C. E. Mercier and W. E. Elliott — The mechanisms of corona occurrence and its effects are analyzed through a study of chemical reactions. Design methods for elimination of corona by means of increased spacing, improved configuration and shielding are discussed and examples are shown. Five methods for testing and locating corona are described.	Nov	140
New Relay Forms for A-C Operation, R. J. Coppola — Existing relays for intrinsic a-c operation using shading coils or polyphase windings, and the various means of operating relays on a-c using auxiliaries such as rectifiers and capacitors all have shortcomings. Presented here are the details in the development of basically new forms of a-c relays, with the electromagnetic design analysis.	Oct	156
A High-K Ceramic Capacitor for 200 C Application, C. A. Shaw — A new type ceramic dielectric is described which will withstand electrical stress of over 50 volts per mil at 200 C. Behavior of dielectric constant, dissipation factor, and insulation resistance *vs* temperature are demonstrated.	Oct	163
Components for Printed Wiring, W. W. Deckert — Detailed description with pictures and outline drawings of current electromechanical component developments sponsored by U.S. Army Signal Engineering Laboratories. Most recent developments include a vertically mounted octal socket, a vertically mounted in-line socket for subminiature flat-press tubes, a vertical and a right-angle mounted transistor socket, a low-voltage subminiature plug and	Sep	92

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receptacle and a subminiature rotary switch. Reliable components for the equipment design engineer are described and illustrated in detail in this article.		
Design Procedures for Special Type High-Temperature Transformers—II, I. Remis Continuation of article begun in July (Part I, p. 116, 10 pp.) presents specific step-by-step design procedures for transformers of the following special types: Current limiting transformers, current limiting transformers with unbalanced d-c magnetization, and vibrator supply transformers. Design example is worked out for 400-cycle transformer for operation at 115 C rise over 85 C ambient.	Aug	119
Design Procedures for Special Type High-Temperature Transformers—I, I. Remis Specific design procedures for high-temperature transformers with unbalanced d-c magnetization.	Jul	116
High-Temperature Magnetic Amplifiers and Transformers, J. R. Walker and M. Frank This 5-watt operational amplifier, shown before encapsulation and after test, has been stabilized with thermistors for an ambient temperature range of —65 to +250 C and operated successfully for 3100 hr at 250 C. Only lack of suitable rectifiers prevents 500 C operation; similar transformer designs have already proven themselves at the higher temperature. Here are the highlights of an Air Force material-component development program evaluating magnetic core materials, conductors, insulation, rectifiers, core mounting methods and encapsulation techniques.	Jun	168
"Inchworm" Motor Overcomes Stick-Slip Phenomenon, J. G. Rubenson and G. S. Butterworth Magnetostriction effect is used to produce a linear actuator for ultra-precise positioning of machine tool slides. By eliminating wind-up inherent in lead screws, chattering of slides or stickiness due to difference between static and running friction is largely overcome.	May	136
Magnet Design: Two Practical Approaches 1. Estimating Leakage Factors for Permanent Magnets from Geometry of Magnetic Circuit, R. K. Tenzer Shows how to figure the leakage factors of various shaped permanent magnet circuits, and unsaturated electromagnetic circuits, by straight arithmetic using only the physical dimensions of the magnetic structure and a few rule-of-thumb constants.	Feb	94
2. Figuring Air Gaps for Maximum Pull of Opposing Electromagnets, K. W. Henderson Graphical method of determining the air gap for maximum initial pull for a given change from the initial ampere-turns of opposing (push-pull) electromagnets.	Feb	98
Human Engineering		
Machine-in-Use Study Guides Redesign, M. Farr Two new British office-machine designs, one for embossing and the other for printing, in which the design consultant made full use of applied psychology research in human factors. The opportunity for depth study of these questions was unique, since the machine manufacturer uses his own machines extensively.	Nov	146
Human Engineering Faults in Test Equipment Design, R. Bilinski Test equipment and skilled testing personnel have become increasingly important as electronic equipment grows in complexity. Human engineering factors should be applied in the design of test equipment to eliminate or minimize badly designed or improperly located components, such as fasteners, cables, jacks, connectors, knobs, lid enclosures and latches. Such design defects seriously impair the efficiency and accuracy of operator's work, and in some instances constitute operational hazards. Based on a U. S. Navy equipment study, examples of poor design are shown and redesigned improvements indicated.	Aug	150
Maintainability		
Equipment Design for Ease of Maintenance, S. J. Lanzalotti Maintenance factors to be considered by the design engineer to reduce equipment "down time" and ease training requirements for maintenance personnel.	Oct	178
Materials Selection Factors		
Functional Fixed Film Resistor Materials, A. E. Middleton Critical elements in the selection of optimum materials for film resistors are discussed. Various properties are compared and interpreted from the standpoint of today's ultimate objectives for resistors designed into an equipment required to operate under severe ambient conditions. The discussion emphasizes the need for tailoring resistor materials from synthesized structure.	May	149
Nomographs		
Logarithmic Conversion Scale for Time, R. F. Graf	Aug	164
Capsule Calculus, I. Ritow A calculus refresher with the emphasis on understanding and developing a feeling for calculus rather than a facility for manipulating symbols to solve problems. Part I develops the basic principles of calculus and discusses differentiation and its uses. Part II discusses integration and its applications. Part III explains the use and meaning of differentiation and integration with respect to time and interprets equations of motion.	May	107
Nuclear Radiation Effects		
Nuclear Shielding Materials for Electronic Circuits, J. R. Hendrickson, Sr. Standard enclosures for electronic circuits fail to provide effective shielding against nuclear radiation. Devices and equipment operating in nuclear-powered aircraft and in other nuclear environments have to be designed with adequate protective shielding. This article reviews the mechanism of nuclear radiation effects, discusses pertinent properties of shielding materials, and presents specific shield design considerations.	Nov	130
Effects of Nuclear Radiation on Electronic Components, R. D. Shelton Resistors, capacitors, insulated wires, electron tubes, semi-conductor devices and printed circuit boards have been operated and tested in nuclear radiation fields in a research program sponsored by the U. S. Air Force. Irradiation of components was continued until component failure or until a specified integrated thermal neutron flux had been reached. This article first reviews mechanisms by which neutrons and gamma radiation affects operation of components, then presents detailed experimental data in graph and tabular form on each group of components. Components of same JAN type made by different manufacturers show variation in nuclear effects.	Sep	76
Effect of Radiation on Semiconductors, J. C. Pigg and C. C. Robinson When high-energy particle bombardment is part of the environment, circuit designs employing semiconductors must include consideration of the effects of crystal lattice disorder. Changes in characteristics of typical semiconductor components when subjected to various radiation levels are described.	Apr	116
Packaging, Electronic		
Packaging Considerations with Semiconductors, W. H. Klippel Miniaturization of electronic subassemblies has been greatly aided by progress in the development and application of transistors and other semiconductor components, paralleled by similar advances in printed circuit and embedded circuit techniques. Practical solutions to problems arising in these general areas are given, based on computer design experience.	Jun	112

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Production Cost

Semi-Automatic Manufacture of a Choke Coil, D. Esperson — Jun — 184

Selenium Rectifiers for High-Voltage Power Supplies, V. Wouk — Mar — 166
Economic considerations in designing higher voltage power supplies indicate that selenium rectifier stacks are best for some applications but outclassed by vacuum tubes for others. Costs are compared for several typical high-voltage circuits.

Radio Noise and Interference

Suppressing Corona in Flyback Transformers, Staff Report — Jan — 128

Reliability

Reliability and the Component Engineer, R. W. Brown — Nov — 126
Role of the component engineering specialist in providing applications engineering data to the circuit designer and packaging specialist. Examples show how a component engineering group may analyze electronic part failures to improve reliability through more realistic parts selection, testing, and application.

Environmental Protection with Hermetic Sealing, W. Brown — Nov — 136
The importance of hermetic sealing in obtaining reliability, in components for commercial as well as military applications, continues to increase as faster speeds and higher altitudes are obtained. The various factors to be considered in choosing the filling gas and in measuring the leakage rate are discussed and some new developments in the field are described. Helpful figures for the design of hermetically sealed units are given for future reference.

Quantitative Criteria for Thermal Evaluation of Electronic Equipment, T. C. Reeves — Sep — 108
Four criteria for quantitative evaluation are developed and their limitations discussed. The most satisfactory criterion present is the Thermal Figure of Merit. Thermal performance is interpreted in terms of its effect on circuit part reliability.

Corrosion of Copper by Electrical Insulation, C. D. Doyle — May — 168

Preferred Circuits—II, Staff Report — Mar — 144
Data covering additional tube circuits are presented together with circuit analysis. Design notes cover a cathode follower for fast rise time pulse applications and a phantastron delay to time modulate a pulse in accordance with a variable quantity.

Preferred Circuits—I, Staff Report — Feb — 101
Standardization program is described and data covering representative tube circuits is presented together with circuit analysis. Two d-c power supply regulators and blocking oscillator frequency divider are described.

Shock and Vibration

Instrumentation Notes for Shock Tests

1. Measurements of Shock and Vibration Under Extreme Environmental Conditions, A. W. Orlacchio — Jan — 82
Types of vibration pickups are described together with factors to be considered in their selection for specific applications. Several examples are presented.

2. How to Select Electromagnetic Vibration Pickups, A. C. Diechmiller — Jan — 78
Design features and applications of vibration pickups for high-frequency vibration testing at high temperatures are described together with several calibration techniques.

Specifications and Standards

International "Rules" on Controlgear—A Progress Report, G. W. Heumann — Nov — 156
A detailed report of the meeting of Subcommittee 17B presenting the basic theory behind the work of the international organization in establishing "Rules" (or Standards) for controlgear and explaining some of the concepts on which foreign purchase specifications may be based.

Photo-Template Techniques for Control Drawings, V. F. Dugar — Oct — 166
A new technique making use of photocopying and symbol templates for standard components permits greater efficiency in preparing wiring diagrams for industrial control equipment in accordance with NEMA specifications.

Advancement in International Electrical Standards, Staff Report — Oct — 182
A composite report of progress made on specifications of switchgear, rectifiers (including semiconductors), lighting equipment, and batteries at the 1957 meeting of the International Electrotechnical Commission held in Moscow.

Proposed Size Standards for Toroidal Magnetic Tape-Wound Cores, P. L. Schmidt — Sep — 122
Selection procedure followed and full text of standard proposed by Materials Subcommittee of AIEE Magnetic Amplifier Committee. Tables cover: (1) proposed standard dimensions (2) commonly used core dimensions not included as proposed standards and (3) proposed standards for the choice of future core dimensions.

Appearance Specifications and Control Methods, W. J. Kiernan — Jul — 126
Appearance has increasingly become a "designed-in" element in any finished product. The color, gloss, and texture of exterior surfaces are important factors in styling and sales appeal, may have an important functional purpose also. The design engineer has a responsibility for selecting and specifying materials so that (1) appearance factors can be related to appropriate standards, and (2) effective process control methods can be established to assure uniformity in quality and characteristics. This article reviews basic premises of appearance control, theories of color specification, and available methods, instrumentation, standards and references.

Symbols and Terminology for Automatic Control Systems, Staff Report — Jul — 149
A progress report of the work of several committees and an attempt to correlate the programs. Agreement reached on basic block diagram of a feedback control system.

JIC Electrical Standards for Industrial Equipment, Joint Industry Conference — Jun — 127
Revised and adopted at the March 20-22, 1957 Joint Industry Conference, Detroit, Michigan.

Further Progress Reported in International Motor Standards, C. W. Falls — Apr — 144
Report of steps taken at Paris in December 1956 toward the merging of metric and inch standards into a single dimensional standard for integral horsepower motors; fractionals far apart.

Thermal Design Factors

Design for Fins for Cooling of Semiconductors, W. Luft — Nov — 98
By employing a minimum of simplifying assumptions, a workable method of analytically designing cooling fins is derived. Semiconductors are used as a typical example of components which permit heat removal by the use of fins. Numerical examples and time-saving nomograms are included to support the general equations presented.

Design Procedures for Special Type High-Temperature Transformers—II, I. Remis — Aug — 119
Continuation of article begun in July (Part I, p. 116, 10 pp.) presents specific step-by-step design procedures for transformers of the following special types: Current limiting transformers, current limiting transformers with unbalanced d-c magnetization, and vibrator supply transformers. Design example is worked

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in some instances constitute operational hazards. Based on a U. S. Navy equipment study,

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Extruded Plastics Find Many Uses in Portable TV, R. Marx — Nov — 158

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out for 400-cycle transformer for operation at 115 C rise over 85 C ambient.		
Integration of Dielectric Materials, Processes, Components, A. E. Javitz — Review of the 1957 symposium of the Electric Insulation Division, Electrochemical Society, covers the wide spectrum of basic and application research, encompasses not only materials but also integrated components and processes.	Jul	90
Design Procedures for Special Type High-Temperature Transformers—I, I. Remis — Specific design procedures for high-temperature transformers with unbalanced d-c magnetization.	Jul	116
High-Temperature Magnetic Amplifiers and Transformers, J. R. Walker and M. Frank — This 5-watt operational amplifier, shown before encapsulation and after test, has been stabilized with thermistors for an ambient temperature range of —65 to +250 C and operated successfully for 3100 hr at 250 C. Only lack of suitable rectifiers prevents 500 C operation; similar transformer designs have already proven themselves at the higher temperature. Here are the highlights of an Air Force material-component development program evaluating magnetic core materials, conductors, insulation, rectifiers, core mounting methods and encapsulation techniques.	Jun	168
Liquid and Gas Dielectrics for Magnetic Component Miniaturization, L. F. Kilham, Jr. and R. R. Ursch — Significant reduction in size and weight has been attained in transformer design by the use of fluorochemical liquids and gases in combination with various heat-conduction techniques. The fluorochemicals combine excellent characteristics as coolants with desirable dielectric and physical properties. These design methods appear applicable to magnetic components generally, for example, inductors and complete power supply packages.	May	140
Thermal Considerations in Power Transistor Applications, B. Reich — Method of determining operating junction temperature of power transistors for steady state and transient conditions based on one thermal measurement and manufacturer's data.	May	162
Predicting Temperature Rise in Servo Motors, R. M. Gitlin and S. A. Davis — Guesswork and broad safety factors are no longer adequate for equipment designs which present temperature rise problems. Analytical methods of thermal evaluation are required for optimum results. In this article the small servo motor is used to illustrate the general logic and the specific calculation methods for both the designers and users of components to apply in equipment development in which heat and temperature are important aspects.	Apr	133
A Reliability Approach to Thermal Design and Evaluation, T. C. Reeves — Methods of arriving at cooling requirements based on acceptable failure rates as determined by reliability goals. Mean life of electronic components is considered a continuous function of temperature level. Methods are described for evaluating developmental or final designs in terms of the effect of the thermal design on reliability.	Feb	83
DRIVES		
Electrical		
Multi-Function Magnetic Amplifier Control for Large Motors, J. Baude — The use of both the dynamic and the static control characteristics of a magnetic amplifier for supervision of relays in the control and protective circuits of large synchronous motors is detailed. The theory of the magnetic amplifier role in this function is presented, with circuit diagrams and descriptions of the complete system.	Oct	170
Electronic Controls for Timed Acceleration of D-C Motors, P. A. Herrmann — Adjustable-voltage, variable-speed drives advance to a higher order of control as linear RC timing networks upgrade conventional programming circuits to Electronic Controls for Timed Acceleration of D-C Motors.	Mar	132
Wide-Range Adjustable Speed from "Straight A-C," E. Anderson — Although little known in this country, the ingenious Schrage motor is widely used by European designers requiring adjustable speed in equipment drives. It is a single-machine drive operating on the induction motor principle; has good efficiency over 20-1 speed range; can be adapted for constant torque or constant horsepower; suitable for regulating, load sharing and feedback systems.	Jan	104
Mechanical		
Combining Hydraulic Torque Converters with A-C Motors, W. Howard — Hydraulic torque converters offer interesting possibilities in shaping the speed-torque characteristics of a-c motors to suit high-inertia loads. Companion benefits afforded by use of converters are shock isolation and virtually unlimited overload protection.	Feb	90
High Speed Digital Positioning with Binary-Coded Air Cylinders, G. E. Comstock, III — Serially connected air cylinders can be used as digital positioning devices by operating each cylinder of the string as an independent binary element that extends or retracts its full stroke length in response to on-off electrical signals applied to its solenoid pilot valve. But smooth, precise performance poses a damping problem that can best be solved with built-in hydraulic damping, controlled by variable orifice.	Feb	116
Flywheel-Clutch Speed Starting of Standby Generator, W. S. Wiseman and J. C. Christiansen	Feb	138
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Regulation Systems for A-C Generators, H. Shapiro — Simple and economical methods of achieving improved regulation in alternators in the 10- to 100-kva size ranges are outlined and compared for their merits for particular applications. The regulation means analyzed range from alternator internal design for better inherent regulation, to the use of a minimum of external equipment such as saturable reactors and dry-disk rectifiers. Applications include railway reefer car and other mobile equipment generators.	Aug	142
INSTRUMENTS AND TEST EQUIPMENT		
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Organizing Vibration Testing Activities in Engineering Development, R. J. Satory — Vibration test group organization responsibility at Bendix Products Division is described, together with types of test performed, and types of specimens; included are design notes for vibration test fixtures.	Dec	152
Design		
Laboratory Shake Table Does Double Duty, E. A. Shepard, Sr.	Aug	155
Human Engineering Faults in Test Equipment Design, R. Bilinski — Test equipment and skilled testing personnel have become increasingly important as electronic equipment grows in complexity. Human engineering factors should be applied in the design of test equipment to eliminate or minimize badly designed or improperly located components, such as fasteners, cables, jacks, connectors, knobs, lid enclosures and latches. Such design defects seriously impair the efficiency and accuracy of operator's work, and	Aug	150

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pilot units were designed and evaluated in comparison with conventional Class A-insu-		
types of metal-insulated laminates for printed-circuit work. Derived data deal with current-		

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in some instances constitute operational hazards. Based on a U. S. Navy equipment study, examples of poor design are shown and redesigned improvements indicated.		
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Electric Clutch Couplings for Instrument Gear Trains, Staff Report	Feb	121
Electric clutch couplings and brakes provide variable paper speeds from 3 to 400 in. per sec, preset automatic cutoff, constant paper tension and easy decoupling of paper rolls in new 16-channel cathode ray recording oscillograph for jet-engine and missile study, designed by William Miller Instruments, Inc.		
MATERIALS, ELECTRICAL/ELECTRONIC		
Conductor Materials		
Fiber Metal Commutator Brushes, C. H. Sump, H. G. Hamre and G. A. Forster	Dec	128
Problem of electrical noise interference generated by slip rings appears to be solved by commutator brushes made from molybdenum fiber and running on a silverplated ring. Surface speeds up to 30,000 fpm are obtained, with no rapid wear, nor overheating.		
High-Nickel Alloy Spring Materials, Staff Report	Sep	102
High strength at high temperature and resistance to corrosion make many of the high-nickel alloys suitable for springs for electrical and electronic application. Electrical conductivity and non-magnetic properties are also governing selection factors. Heat-treating procedures for obtaining optimum mechanical properties are given. Text is largely supported by tabular property data.		
Integration of Dielectric Materials, Processes, Components, A. E. Javitz	Jul	90
Review of the 1957 symposium of the Electric Insulation Division, Electrochemical Society, covers the wide spectrum of basic and application research, encompasses not only materials but also integrated components and processes.		
Aluminum-Clad Copper Magnet Wire for Elevated-Temperature Use, C. L. Carlson	Jun	164
Composite wire combines the electrical conductivity of copper with the oxidation resistance of aluminum. In the range of 100 C to 300 C the loss of current-carrying ability is less than that of copper. Details of research and fabrication problems and some evaluation data for such applications as motor design are given in this report.		
Corrosion of Copper by Electrical Insulation, C. D. Doyle	May	168
Considerations in the Design of Aluminum Foil Coils, H. O. Rost	Mar	163
Experimental magnet coils wound from aluminum foil with capacitor kraft paper as layer insulation have proved to have superior heat distribution and space utilization, compared with copper wire. Coil weight was halved, material cost reduced 20 to 40 per cent.		
Contact Materials		
Determination of Impurities in Fine Silver, J. R. Luck and E. H. Lindemann	Feb	136
Electrical Insulation and Dielectrics		
Research Progress in Dielectrics—1957, A. E. Javitz	Dec	94
Eleventh consecutive annual staff report on the Conference on Electrical Insulation (National Academy of Sciences—National Research Council). Papers and round-table discussions are summarized and interpreted, test results are given. Synthesis of materials for supersonic missile and aircraft requirements; behavior of silicones under radiation; degradation of Mylar film; insulation life of flexible insulation; mechanisms of electrical breakdown; and "treeing" in polyethylene cable are among subjects discussed.		
Extruded Plastics Find Many Uses in Portable TV, R. Marx	Nov	158
Composite Fluorocarbon Laminates for Printed Wiring, L. B. Allen, D. E. McElroy and S. J. Stein	Oct	124
Copper foil is bonded by special process to a polymonochlorotrifluoroethylene film which is in turn backed by either XXXP phenolic or glass-epoxy laminate. Resulting multiple structure, when etched, retains the high electrical properties of the fluorocarbon surface, especially superior arc resistance even under severe humidity. Single- and double-faced laminates can be made, and other backing materials used.		
Direct-Bonded Copper-Clad Teflon High-Temperature Laminate, D. E. McElroy and S. J. Stein	Oct	126
New type of fluorocarbon resin, Du Pont's Teflon 100X perfluorocarbon, which can be fabricated directly by standard extrusion and molding techniques, is bonded directly to copper to form a 200 C printed wiring board of superior characteristics. The direct bond enables the resin surface to retain its inherent high electrical properties after the circuit has been etched.		
Evaluation of Enameled Magnet Wire Properties and Applications, J. L. Saums and W. W. Pendelton	Oct	129
A workable knowledge of magnet wire types, their advantages and limitations, as related to specific product applications, aids a design engineer in the selection of the best wire for his own purposes and in the specification of components and equipments that incorporate magnet wire. This review provides extensive property data on the major types of enameled wire, including those with newer enamels such as polyurethanes, nylon, epoxies, acrylics and polyesters, compares advantages and disadvantages, lists trade names.		
PVC Electrode Insulation Ups Storage Battery Capacity, L. E. Wells	Oct	187
Isocyanate-Resin-Coated Elastomeric Insulation, H. G. Steffens	Sep	113
An elastomeric material, available as sleeving and tape, represents a further step in the development of isocyanate-resin insulation. Original isocyanate coating, introduced in 1956, showed some application limitations owing to rigidity inherent in the cross-linked structure. New material adds flexibility to already established good physical and dielectric properties. Comparative evaluation test data are presented for extensibility, resilience and other properties, also for aging tests at the rated temperature of 150 C, and at 170 C.		
Evaluation Tests for Epoxy Casting Systems, M. V. Goodyear and J. P. Hornburg	Sep	125
A 5-point "heat-endurance" test method is described as a means for obtaining qualitative test data on the performance of epoxy casting resin systems under service conditions, including elevated temperatures. Good correlation has been established between these tests and application requirements. The test method is also useful for screening raw materials for the resin systems, such as filler, plasticizers and hardeners. Epoxy-hardener systems include acid anhydrides, aliphatic and aromatic amines, and combinations of these. Comparisons are given between solid and liquid epoxy resins, reactive and non-reactive plasticizers, and filled and unfilled systems. Tests are reported at 130 C, 150 C, 175 C and 200 C.		
Design and Cost Advantages in Class H-Insulated Integral-Hp Motors, J. F. Dexter	Aug	109
Use of Class A insulation limits size and weight reduction in motors, since adequate surface area is needed for the required rapid heat dissipation. With availability of Class H insulation this limitation may be overcome. To investigate functional use of silicone insulating systems in integral-hp motors, 7½-hp TEFC		

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pilot units were designed and evaluated in comparison with conventional Class A-insulated motors of the same rating. Evaluation data indicate characteristics are essentially the same, but silicone-insulated units are about one-half the size and weight, and cut copper and steel requirements by almost 50 per cent.		
Integration of Dielectric Materials, Processes, Components, A. E. Javitz — Review of the 1957 symposium of the Electric Insulation Division, Electrochemical Society, covers the wide spectrum of basic and application research, encompasses not only materials but also integrated components and processes.	Jul	90
R-F Power Ratings for Subminiature Coaxial Cables, G. J. Mares and N. J. Sladek — Knowledge of power rating values is essential for proper applications of subminiature coaxial cables in electronic equipment. Miniaturization of equipment, higher power requirements, and subsequent higher ambient temperatures combine to create critical design problems. Suitable subminiature connector systems form a corrolary problem. Comparative data on polyethylene and two types of fluorocarbon dielectric coaxial cables are presented here; also on specially designed con nector systems.	Jul	140
Appplications for Glass Materials and Components, J. K. Davis — From electron tube envelope to nuclear radiation detecting devices, technical glass fills a wide spectrum of vital and primary needs as an engineering material in the design of electrically energized equipment, appliances and machines. Three categories of application are reviewed here: Glass as a structural material; glass electronic and electrical components; glass for special-purpose application.	Jun	151
High-Temperature Magnetic Amplifiers and Transformers, J. R. Walker and M. Frank — This 5-watt operational amplifier, shown before encapsulation and after test, has been stabilized with thermistors for an ambient temperature range of —65 to +250 C and operated successfully for 3100 hr at 250 C. Only lack of suitable rectifiers prevents 500 C operation; similar transformer designs have already proven themselves at the higher temperature. Here are the highlights of an Air Force material-component development program evaluating magnetic core materials, conductors, insulation, rectifiers, core mounting methods and encapsulation techniques.	Jun	168
Insulation Problems in Submerged Pump Motors, M. J. Carroccio	Jun	178
Liquid and Gas Dielectrics for Magnetic Component Miniaturization, L. F. Kilham, Jr. and R. R. Ursch — Significant reduction in size and weight has been attained in transformer design by the use of fluorochemical liquids and gases in combination with various heat-conduction techniques. The fluorochemicals combine excellent characteristics as coolants with desirable dielectric and physical properties. These design methods appear applicable to magnetic components generally—for example, inductors and complete power supply packages.	May	140
Fluorinated Liquid Dielectric for Fixed Paper Capacitors, T. D. Callinan and J. B. Romans — Materials usable over a temperature range —65 C to 200 C have been developed from synthesis of partially fluorinated compounds. Properties of these materials and characteristics of impregnated capacitors are discussed in this report based on a Naval Research Laboratory program.	May	146
Corrosion of Copper by Electrical Insulation, C. D. Doyle	May	168
Characteristics of Metal-Clad Laminates, D. S. Hoynes — Results of a Navy Bureau of Ships-sponsored project to develop design data on several types of metal-insulated laminates for printed-circuit work. Derived data deal with current-carrying capacity, electrical resistance of coated laminates, and dielectric properties.	Apr	104
High-Temperature Inorganic Insulation, L. W. Spooner — Relatively inexpensive compounds of asbestos bonded with 100 per cent inorganic aluminum phosphate provide electrical insulation for service up to 250 C.	Apr	130
Developments in Polyethylene Insulation, A. E. Javitz — Outstanding electrical properties of polyethylene have won for it wide acceptance as wire and cable insulation. Some deficiencies in properties limit greater use. As a result of developments in basic polymer chemistry, new types with improved properties are becoming available. This special report examines the new types, re-examines standard materials, and appraises application potentials.	Mar	108
High-Temperature Solventless Encapsulating Resins, D. W. Lewis — A class of solventless resins reviewed here combines the established outstanding thermal and dielectric properties of the silicones with the advantages of compounds that can cure without release of volatiles. A homogeneous compact cured structure is thus obtained free from cracks and voids, assuring optimum thermal dissipation and preventing internal corona. Long-range service of the order of 10 yr at 200 C is indicated.	Mar	141
Silicone Materials in Appliance Design, J. F. Dexter — First of the "newer" high-temperature materials, the silicones made their primary design contribution as electrical insulation in motors, transformers and other equipment required to operate under severe ambient conditions. The use of silicones (resins, rubber, oils and greases) in appliances is less well known, but it exploits the same combination of properties headed by thermal stability over a wide temperature range.	Feb	78
Slot Insulation Materials, P. Hedrick	Feb	142
Resin-Embedment Process Control for Optimum Electronic Package Design, C. A. Harper — Chemical processes in the embedment, encapsulation and potting of electronic packages by means of epoxy- or polyester-base resins are not simple. Their successful use requires proper controls throughout the system and extreme care in package design. Proper design of embedded electronic packages can best be achieved by cooperation between the process engineer and the product design engineer.	Jan	85
New Glass Dielectrics, W. E. Hauth and A. L. Pugh — Several new compositions, based primarily on the use of major amounts of titanium dioxide, appear to show excellent application possibilities by virtue of high dielectric constant, low dissipation factor, and moisture stability. These materials may be worked by automatic equipment at conventional temperatures. Applications include high-temperature capacitors, high-temperature insulators and capacitors, glass-to-metal seals, and sintered glass shapes.	Jan	100
Suppressing Corona in Flyback Transformers, Staff Report	Jan	128

Magnetic Materials

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Magnetic Tape Rolled from Powdered Metals, C. E. Richards — A summary of British experimental and commercial experience in developing high quality magnetic core materials by powder metallurgy techniques. Primary advantage is close control of alloy composition to minimize batch-to-batch variations in magnetic properties. Data given for: high permeability alloys; high flux density alloys—non-oriented, domain-oriented and grain-oriented; switching alloys—including a new high-molybdenum alloy.	Dec	104

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fectively by tabular arrangement of data, par-		
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Magnetic Properties of High-Aluminum Iron Alloys, D. Pavlovic and K. Foster — Nov — 109
The magnetic characteristics of 14 to 17 per cent (by weight) aluminum-iron alloys which have been recently developed compared to oriented 3 per cent silicon iron and 50 per cent nickel iron. Also, comparative data on two new high-permeability low-remanence aluminum-iron alloys with residual induction of less than 1 kilogauss—without an air gap.

Applying Ceramic Permanent Magnets to Motor Design, G. R. Hennig — Jul — 100
In the design of permanent magnet fields for small d-c motors, the magnetic material used has an important influence. The newer ceramic materials—both oriented and non-oriented—require different design approaches than those developed for Alnico magnets, and also provide new design opportunities.

High-Temperature Magnetic Amplifiers and Transformers, J. R. Walker and M. Frank — Jun — 168
This 5-watt operational amplifier, shown before encapsulation and after test, has been stabilized with thermistors for an ambient temperature range of —65 to +250 C and operated successfully for 3100 hr at 250 C. Only lack of suitable rectifiers prevents 500 C operation; similar transformer designs have already proven themselves at the higher temperature. Here are the highlights of an Air Force material-component development program evaluating magnetic core materials, conductors, insulation, rectifiers, core mounting methods and encapsulation techniques.

Applying High Permeability Laminations, W. S. Spring — Mar — 126
A quick review of basic design factors for high-nickel-alloy magnetic laminations, including the effects on a-c permeability of alloy composition, lamination shape and thickness, stacking and interleaving, superposed d-c fields and final heat treatment. Brand names and lamination symbols defined.

Magnetic Materials Push Back Design "Stops," W. Arrott — Jan — 62
An advance look at new and improved magnetic materials, material-components and techniques as disclosed at the AIEE Conference on Magnetism and Magnetic Materials. Selected papers reviewed on Permanent Magnets, Soft Magnetic Materials, Ferrites and Thin Films, Test Methods and Apparatus, New Devices and Components.

MATERIALS, MECHANICAL/STRUCTURAL

Composite Materials

Testing Bond Strengths of Copper Clad Laminates, J. O. Barlon, J. A. Brown and P. H. Nash — May — 170

Metals

High-Nickel Alloy Spring Materials, Staff Report — Sep — 102
High strength at high temperature and resistance to corrosion make many of the high-nickel alloys suitable for springs for electrical and electronic application. Electrical conductivity and non-magnetic properties are also governing selection factors. Heat-treating procedures for obtaining optimum mechanical properties are given. Text is largely supported by tabular property data.

Design Limits Set by Tooling for Powder Metal Parts, G. G. Karian — Feb — 110
An understanding of tool design factors for powder metal compacts should lead to design of parts for electrical and electrically energized products that take full advantage of this versatile technique. Five classes of parts and tools are illustrated in ascending order of difficulty.

Nonmetallic Materials

Extruded Plastics Find Many Uses in Portable TV, R. Marx — Nov — 158

Appplications for Glass Materials and Components, J. K. Davis — Jun — 151
From electron tube envelope to nuclear radiation detecting devices, technical glass fills a wide spectrum of vital and primary needs as an engineering material in the design of electrically energized equipment, appliances and machines. Three categories of application are reviewed here: Glass as a structural material; glass electronic and electrical components; glass for special-purpose application.

Ceramic Developed for Induction Brazing Jig, Staff Report — Apr — 168

Silicone Materials in Appliance Design, J. F. Dexter — Feb — 78
First of the "newer" high-temperature materials, the silicones made their primary design contribution as electrical insulation in motors, transformers and other equipment required to operate under severe ambient conditions. The use of silicones (resins, rubber, oils and greases) in appliances is less well known, but it exploits the same combination of properties, headed by thermal stability over a wide temperature range.

Thermal and Acoustical Insulation

Thermal and Acoustical Insulation Requirements, S. Joyce — Aug — 90
Materials are analyzed in terms of design problems in refrigerated equipment: ranges and other heated appliances; home and commercial laundry and dishwashing appliances; air conditioning and heating equipment. Improved fibrous glass thermal insulations are described, particularly in relation to new design concepts, such as "wrap-around" and thin-wall constructions. Characteristics and applications are also given for gas-filled insulation. Use of fibrous glass in acoustical insulation is described. Living-space location for appliances is now a factor in consumer demand for noise-reduction in home equipment. Property graphs, tables, and temperature analysis charts.

MOTORS

Integral-Horsepower

Design and Cost Advantages in Class H-Insulated Integral-Hp Motors, J. F. Dexter — Aug — 109
Use of Class A insulation limits size and weight reduction in motors, since adequate surface area is needed for the required rapid heat dissipation. With availability of Class H insulation this limitation may be overcome. To investigate functional use of silicone insulating systems in integral-hp motors, 7½-hp TEFC pilot units were designed and evaluated in comparison with conventional Class A-insulated motors of the same rating. Evaluation data indicate characteristics are essentially the same, but silicone-insulated units are about one-half the size and weight, and cut copper and steel requirements by almost 50 per cent.

New Elements for Static Control, Staff Report — Jul — 106
Development in high-performance d-c motors and d-c power sources also featured at 21st Westinghouse Machine Tool Electrification Forum: new Cypak static elements; output magnetic amplifier; half-shift register module; transistor NOR circuit; dynistor diode switch.

Further Progress Reported in International Motor Standards, C. W. Falls — Apr — 144
Report of steps taken at Paris in December 1956 toward the merging of metric and inch standards into a single dimensional standard for integral horsepower motors; fractionals far apart.

D-C Motor Features for Wide Speed Range, D. J. Luckley, Jr. — Apr — 163

Capacitor Start/Run of 15-Hp Single-Phase Motors, C. H. Crouse — Mar — 170

Fractional-Horsepower

Graphic Form for Operating Instruction Accuracy, F. K. Dudey — Dec — 109
The transmission of technical information to production personnel can be accomplished ef-

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fectively by tabular arrangement of data, particularly instructions for testing or processing in which a particular equipment operation sequence is to be specified. The advantages of this form of presentation are indicated, in its conciseness and ready accessibility for engineering analysis. Examples of graphic operating instructions are given in detail.		
Applying Ceramic Permanent Magnets to Motor Design, G. R. Hennig	Jul	100
In the design of permanent magnet fields for small d-c motors, the magnetic material used has an important influence. The newer ceramic materials — both oriented and non-oriented — require different design approaches than those developed for Alnico magnets, and also provide new design opportunities.		
Start-Run Protection for Split-Phase Motors, J. Ellenberger	Jan	90
Careful protection of split-phase motors yields more than just the benefit of safe operation. Higher torques in smaller frames can also be realized if the start-winding control is foolproof enough. New thermal devices promise to make such control feasible.		
Matching a Universal Motor to its Load, J. J. Meadows	Jan	115
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Servo Motor Performance Under Unbalanced Conditions, T. N. Feng	Nov	166
"Flexible Standard" A-C Aircraft Motors, J. P. Barrett	Jul	156
Wrist Watch Project Yields Subminiature Motor, Staff Report	Jul	160
Insulation Problems in Submerged Pump Motors, M. J. Carroccio	Jun	178
"Inchworm" Motor Overcomes Stick-Slip Phenomenon, J. G. Rubenson and G. S. Butterworth	May	136
Magnetostriction effect is used to produce a linear actuator for ultra-precise positioning of machine tool slides. By eliminating wind-up inherent in lead screws, chattering of slides or stickiness due to difference between static and running friction is largely overcome.		
Predicting Temperature Rise in Servo Motors, R. M. Gitlin and S. A. Davis	Apr	133
Guesswork and broad safety factors are no longer adequate for equipment designs which present temperature rise problems. Analytical methods of thermal evaluation are required for optimum results. In this article the small servo motor is used to illustrate the general logic and the specific calculation methods for both the designers and users of components to apply in equipment development in which heat and temperature are important aspects.		
Materials Study for Low Cost Miniature Motor, A. H. Kent	Apr	160
Wide-Range Adjustable Speed from "Straight A-C," E. Anderson	Jan	104
Although little known in this country, the ingenious Schrage motor is widely used by European designers requiring adjustable speed in equipment drives. It is a single-machine drive operating on the induction motor principle; has good efficiency over 20-1 speed range; can be adapted for constant torque or constant horsepower; suitable for regulating, load sharing and feedback systems.		
PRODUCT DESIGN CASE HISTORY		
Appliances		
Machine-in-Use Study Guides Redesign, M. Farr	Nov	146
Two new British office-machine designs, one for embossing and the other for printing, in which the design consultant made full use of applied psychology research in human factors. The opportunity for depth study of these questions was unique, since the machine manufacturer also extensively uses his own machines.		
Development of Starter for Domestic Lawn Mowers, W. R. Johnson and G. K. Isaacs	Oct	184
Electrical Controls Permit Non-Critical Design Details, Staff Report	May	156
Unusual unity of electrical and structural design in a strongly competitive produce field marks the new "Corsair 20" cigarette vendor. Early adoption and then rigorous maintenance of a development philosophy geared to manufacture and sales realities, keynoted by the concept of simple broad-gaged mechanisms, paid dividends in an end-product that has had immediate acceptance.		
Industrial Machinery		
Ultrasonic Dispersion from Fluid-Flow Energy, Staff Report	Dec	144
The dynamics of jet-flow of fluids and resulting cavitation for ultrasonic dispersion and emulsifying is effectively used for the design of a line of mixers. The development sequence and the problems encountered in the course of converting the principle into working, efficient products are detailed.		
Transformer and Reactors Combined in Welding Rectifier, M. Mamon	Jul	153
Induction Heating Alternators Stress Life and Service, H. Shapiro	May	166
Miscellaneous		
Quick-Make Manual Circuit Breaker Mechanism, Staff Report	Dec	150
Pictorial presentation of spring-operated "stored-energy" mechanism for minimizing arcing during contact closure of manually operated power circuit breaker by making contact-closing force and timing independent of operator's skill.		
Magnetic Separator Gets New Design, R. M. Wickham	Sep	146
First Electric Wrist Watch, Staff Report	Feb	133
Hamilton's new timepiece has no mainspring and employs a permanent-magnet motor, using the balance wheel as the rotor element with armature coil supplied with electric current from a lozenge-size energy cell with life of a year.		
PRODUCTION AND ASSEMBLY TECHNIQUES		
Automatic Assembly		
Semi-Automatic Manufacture of a Choke Coil, D. Esperson	Jun	184
Embedded Circuits and Components		
High-Temperature Solventless Encapsulating Resins, D. W. Lewis	Mar	141
A class of solventless resins reviewed here combines the established outstanding thermal and dielectric properties of the silicones with the advantages of compounds that can cure without release of volatiles. A homogeneous compact cured structure is thus obtained free from cracks and voids, assuring optimum thermal dissipation and preventing internal corona. Long-range service of the order of 10 yr at 200 C is indicated.		
Resin-Embedment Process Control for Optimum Electronic Package Design, C. A. Harper	Jan	85
Chemical processes in the embedment, encapsulation and potting of electronic packages by means of epoxy- or polyester-base resins are not simple. Their successful use requires proper controls throughout the system and extreme care in package design. Proper design of embedded electronic packages can best be achieved by cooperation between the process engineer and the product design engineer.		
Hermetic Sealing		
Environmental Protection with Hermetic Sealing, W. Brown	Nov	136
The importance of hermetic sealing in obtaining reliability, in components for commercial as well as military applications, continues to increase as faster speeds and higher altitudes are obtained. The various factors to be considered in choosing the filling gas and in meas-		

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uring the leakage rate are discussed and some new developments in the field are described. Helpful figures for the design of hermetically sealed units are given for future reference.

Miscellaneous

Graphic Form for Operating Instruction Accuracy, F. K. Dudey — Dec — 109
The transmission of technical information to production personnel can be accomplished effectively by tabular arrangement of data, particularly instructions for testing or processing in which a particular equipment operation sequence is to be specified. The advantages of this form of presentation are indicated, in its conciseness and ready accessibility for engineering analysis. Examples of graphic operating instructions are given in detail.

Automatic Stripper Speeds Coil Production, R. G. Roesch — Sep — 140

Molded Slip-Rings in British Instruments, W. Sekules — Aug — 158

Wire Stripping Machine for Heavy Insulated Wire, R. G. Roesch — Jun — 177

Ceramic Developed for Induction Brazing Jig, Staff Report — Apr — 168

Considerations in the Design of Aluminum Foil Coils, H. O. Rost — Mar — 163
Experimental magnet coils wound from aluminum foil with capacitor kraft paper as layer insulation have proved to have superior heat distribution and space utilization, compared with copper wire. Coil weight was halved, material cost reduced 20 to 40 per cent.

Hand Calibrating Precision Potentiometer Dials, E. Osterland — Mar — 174

Basic Consideration in Foil Transformer Production, W. Brackmann, R. Levinsohn and D. McCarthy — Jan — 94
Progress report on early development work being carried on under an Air Force contract to demonstrate feasibility of mechanizing small transformer (250 va max.) production using wafer coils spirally wound from aluminum or copper foil. Space factor of aluminum foil superior to copper magnet wire.

Printed Wiring

Mechanized Soldering of Printed Circuit Boards
1. Semi-Automatic Dip-Soldering Machine, T. Gates — Aug — 147
2. "Flowsolder" System, J. Gogan — Aug — 148
Control of depth of immersion and dwell time obtainable over hand methods are advantages of two commercial types of machines, one using a motorized plunger action, the other, from England, employing a stationary wave of solder pumped clean from bottom of bath. Some precautions are given to prevent filling holes.

A Shortcut to Producing Printed Conductor Boards, E. E. Bond, J. E. Butcher and R. F. Caskie, Jr. — Aug — 156

Packaging Considerations with Semiconductors, W. H. Klippel — Jun — 112
Miniaturization of electronic subassemblies has been greatly aided by progress in the development and application of transistors and other semiconductor components, paralleled by similar advances in printed circuit and embedded circuit techniques. Practical solutions to problems arising in these general areas are given, based on computer design experience.

Dip Soldering Printed Circuits, E. S. Miller and A. A. Johns, Jr. — Feb — 124
A subminiature printed circuit system is described which consists of a group of axial-lead components mounted and dip soldered between two parallel photo-etched boards Solder bath considerations are discussed and a dip-soldering machine is described.

Printed Circuits by Electrostatic Methods, B. Darrel and S. Szpak — Feb — 130
Charging and selective discharging of photoconductive films followed by dusting of resinous material, which is then fixed, is a process which has the advantage of being dry and hence especially adaptable in mechanization. One method of producing a pattern is by exposure to light, the other by transfer from a shaped capacitor plate.

Soldering and Solderless Techniques

Stainless Steel Can Be Soldered, G. W. Hinkle — Sep — 143

Mechanized Soldering of Printed Circuit Boards
1. Semi-Automatic Dip-Soldering Machine, T. Gates — Aug — 147
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Control of depth of immersion and dwell time obtainable over hand methods are advantages of two commercial types of machines, one using a motorized plunger action, the other, from England, employing a stationary wave of solder pumped clean from bottom of bath. Some precautions are given to prevent filling holes.

Resistance Soldering Speeds Production, E. Harfst — Jul — 155

Ultrasonic Metal Joining, J. B. Jones and E. E. Weismantel — Apr — 125
Ultrasonic energy is being used in soldering, brazing, and welding. These processes are particularly applicable to specialized joining problems in electrical design. Improved joint reliability is achieved through elimination of flux, and cost savings can be effected by substituting aluminum for copper in electrical assemblies.

Evaluation of Dip-Soldered Joints, E. S. Miller and A. A. Johns, Jr. — Mar — 157
Test program results reveal factors influencing dip-soldered joint characteristics. What can be expected in production is described together with recommended design modifications and production techniques to achieve greater tensile strength.

Dip Soldering Printed Circuits, E. S. Miller and A. A. Johns, Jr. — Feb — 124
A subminiature printed circuit system is described which consists of a group of axial-lead components mounted and dip soldered between two parallel photo-etched boards. Solder bath considerations are discussed and a dip-soldering machine is described.

TESTING

Components

Specification and Measurement of Power Transistor Parameters, B. Reich — Nov — 149
A description of the most important power transistor parameters and applicable measurement circuits. Maximum voltage and current, collector and emitter cut-off current, large signal characteristics and transconductance are included.

Measurement of Resistor Temperature Coefficient, E. Thompson — Aug — 106
Effects of errors in maintaining nominal test temperature and in resistance bridge accuracy on temperature coefficient readings are shown graphically for standard temperature increments. A high accuracy resistance measuring bridge is described that uses a precision potentiometer and vacuum tube amplifier instead of decade resistances and is good for a range of ±500 ppm in TC measurement.

Measuring Starting Torque During Environmental Tests, T. F. Konzal — Jul — 152

Optical Comparator Checks Torque Motor Output, Staff Report — Jun — 175

Considerations in Testing Thermistors, M. L. Miller — May — 102
Proper measurement techniques described for thermistor acceptance and design testing include resistance, voltage, time delay and temperature-resistance slope.

Environmental

Organizing Vibration Testing Activities in Engineering Development, R. J. Satory — Dec — 152
Vibration test group organization and respon-

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sibility at Bendix Products Division is described, together with types of test performed, and types of specimens; included are design notes for vibration test fixtures.		
Laboratory Shake Table Does Double Duty, E. A. Shepard, Sr.	Aug	155
Review of Environmental Test Equipment, J. Cammarata Points to consider in specifying environmental test equipment of various types. Environmental equipment manufacturers and their products are listed for ready reference.	May	127
Instrumentation Notes for Shock Tests		
1. Measurements of Shock and Vibration Under Extreme Environmental Conditions, A. W. Orlacchio Types of vibration pickups are described together with factors to be considered in their selection for specific applications. Several examples are presented.	Jan	82
2. How to Select Electromagnetic Vibration Pickups, A. C. Diechmiller Design features and applications of vibration pickups for high-frequency vibration testing at high temperatures are described together with several calibration techniques.	Jan	78
Materials		
Analysis and Elimination of Corona Effects, C. E. Mercier and W. E. Elliott The mechanisms of corona occurrence and its effects are analyzed through a study of chemical reactions. Design methods for elimination of corona by means of increased spacing, improved configuration, and shielding are discussed and examples are shown. Five methods for testing and locating corona are described.	Nov	140
Measuring Magnetostriction in Transformer Laminations, J. R. Neff and E. S. Anolick	Nov	160
Evaluation Tests for Epoxy Casting Systems, M. V. Goodyear and J. P. Hornburg A 5-point "heat-endurance" test method is described as a means for obtaining qualitative test data on the performance of epoxy casting resin systems under service conditions, including elevated temperatures. Good correlation has been established between these tests and application requirements. The test method is also useful for screening raw materials for the resin systems, such as filler, plasticizers and hardeners. Epoxy-hardener systems include acid anhydrides, aliphatic and aromatic amines, and combinations of these. Comparisons are given between solid and liquid epoxy resins, reactive and non-reactive plasticizers, and filled and unfilled systems. Tests are reported at 130 C, 150 C, 175 C and 200 C.	Sep	125
Testing Bond Strengths of Copper Clad Laminates, J. O. Barlon, J. A. Brown and P. H. Nash	May	170
Determination of Impurities in Fine Silver, J. R. Luck and E. H. Lindemann	Feb	136
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Graphic Form for Operating Instruction Accuracy, F. K. Dudey The transmission of technical information to production personnel can be accomplished effectively by tabular arrangement of data, particularly instructions for testing or processing in which a particular equipment operation sequence is to be specified. The advantages of this form of presentation are indicated, in its conciseness and ready accessibility for engineering analysis. Examples of graphic operating instructions are given in detail.	Dec	109
Sources of Error in Production Testing, J. L. Oldenkamp Methods are outlined for making simple experimental investigations to evaluate the various inevitable errors in production testing and gaging. This process is urged in order that the tested product be not considered solely responsible for the entire variation in observed test data. Tests on small motors are used to illustrate the statistical methods employed.	Sep	89
Automatic Testing Techniques, Staff Report To save man-hours in testing of complex military electronic components and systems, Westinghouse Air Arm Division has mechanized much of its production test facilities. Specific automatic testing systems described herein include an automatic encapsulated unit test set, a test stand for fire control computers, broad-range function tester, and a precision potentiometer checker.	Apr	156
Systems		
Frictionless Commutator Pulse Generator, V. Petrucelly	Sep	144
Automatic Tester Simulates Circuits for Control Panels, E. J. Loeffler and J. R. Longenecker Descriptions of a "homemade" system for checking out, in a matter of minutes, complex machine tool control panels prior to mounting on the machine. Heart of system is motor-driven cam drum, made of wood, with associated limit switches and signal lights. Simulated circuit principles demonstrated by case history of automatic turret lathe.	Aug	97
Production Testing of Servomechanisms, H. R. Walker For routinized testing and calibration of components and elements of complete servo systems, methods are derived from rigorous control theory. Illustrative loops and graphs are included to support the reasoning and as specific references for engineers having the problem of devising technically sound production test methods which are usable by medium-skilled production personnel.	Aug	114
Dual Circuit Electronic Motor Control, J. J. Dailey, Jr. Despite major advances in electron tube technology and quality control, these devices as a class exhibit failure patterns which are inherently random and unpredictable. This has created a dilemma for industrial control designers who must have the undisputed sensitivity and versatility of tubes but can not tolerate unpredictable equipment shutdown. Described here are two simple but effective expedients which permit the use of tubes in a motor regulating circuit for equipment drive in which continuous reliable operation is a paramount requirement.	Jul	144
The Dry Circuit Problem, W. A. Scism, Sr. Some further thoughts on the unpredictable failure of relay contacts to close a circuit when handling milliamperes at millivolts, particularly important in military electronic systems. "Miss" test circuit illustrated.	Jan	111

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Solenoids	Components, Electrical/Electronic (*Magnetic Components*)
Space and Weight Factors	Design Considerations
Special Motors	Motors
Specifications and Standards	Design Considerations
Springs	Components, Mechanical/Structural
Storage Devices	Components, Electrical/Electronic
Switches	Components, Electrical/Electronic
Systems, Testing	Testing
Systems and Servos	Control
T	
Temperature Limits	Testing (*Materials*)
Terminals	Components, Electrical/Electronic (*Wiring Devices*)
Test Equipment	Instrument and Test Equipment
Theory, Control	Control
Thermal and Acoustical Insulation	Materials, Mechanical/Structural
Thermal Design Factors	Design Considerations
Thermal Dissipation	Design Considerations (*Thermal Design Factors*)
Thermistors	Components, Electrical/Electronic (*Semiconductor Devices*)
Thermostats	Components, Electrical/Electronic (*Transducers*)
Transducers	Components, Electrical/Electronic
Transformers	Components, Electrical/Electronic (*Magnetic Components*)
Transistors	Components, Electrical/Electronic (*Semiconductor Devices*)
TV and Radios	Product Design Case History (*Appliances*)
U	
Unitized Construction	Production and Assembly Techniques
V	
Varnishes, Insulating	Materials, Electrical/Electronic (*Electrical Insulation and Dielectrics*)
W	
Waveguides	Components, Electrical/Electronic (*Wire and Cables*)
Wire and Cables	Components, Electrical/Electronic
Wire Enamel and Insulation	Materials, Electrical/Electronic (*Electrical Insulation and Dielectrics*)
Wiring Devices	Components, Electrical/Electronic
Wiring Harness	Components, Electrical/Electronic (*Wire and Cables*)